

## Sri Venkateswara College

COURSES OFFERED BY DEPARTMENT OF  
BOTANY, BIOCHEMISTRY, ZOOLOGY, CHEMISTRY AND PHYSICS

### B.Sc. (Hons.) Biological Science

#### *Category-I*

#### **DISCIPLINE SPECIFIC CORE COURSE – 01: Basic concepts of Biomolecules**

#### **CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE**

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (If any)
		Lecture	Tutorial	Practical/Practice		
Basic concepts of Biomolecules	DSC-101	2	0	2	10+2 from any recognized Board with Biology & Candidates must appear in CUET in the following subject combination: <b>Physics+ Chemistry+ Biotechnology</b> <b>Biology/</b>	Nil

#### **Learning Objectives**

The Learning Objectives of this course are as follows:

- to develop a basic understanding of the structure, bonding, stability, stereochemistry and reactivity of organic molecules with focus on biomolecules.
- This basic knowledge will empower the students to develop an understanding about chemistry and biology of biomolecules such as proteins and nucleic acids. This course also provides a basic understanding of the chemistry of carbohydrates and lipids.
- This knowledge will help students to better understand the biological applications of these biomolecules.

#### **Learning outcomes**

The Learning Outcomes of this course are as follows:

- Understand and apply the fundamental principles of chemistry which include bonding, electronic effects, molecular forces and stability of reactive intermediates to biomolecules.
- Gain an insight into the influence of chemical bond polarization on a molecular structure and its reactivity.
- Identify the type of metabolic reaction and draw reaction mechanisms for key metabolic processes.
- Recognize stereochemistry of a biomolecule and give a rational explanation of its biological reactivity based on stereochemistry.
- Understand the chemistry and biological functions of carbohydrates and lipids

## **SYLLABUS OF DSC-1**

### **Unit I: Basic Concepts** **6 hours**

Electronic displacements and their applications: Inductive, electromeric, resonance and hyperconjugation. Dipole moment, acidity and basicity. Types, shape and relative stability of carbocations, carbanions and free radicals. Electrophiles and nucleophiles, Intramolecular and intermolecular molecular forces including hydrophobic, hydrophilic interactions and hydrogen bond (emphasis on effect of these forces on the stability of biomolecules),

### **Unit II: Stereochemistry** **( 8 hours)**

Stereochemistry and its importance to biological systems, Stereoisomerism: Optical activity and optical isomerism, asymmetry, chirality, enantiomers, diastereomers. Mesomers, specific rotation; Resolution of racemic modification, Configuration and projection formulae: Newmann, Sawhorse, Fischer projections and their interconversion. Chirality in molecules with one and two stereocentres; CIP rules: Erythro/Threo, D/L and R/S designations.; Relative and absolute configuration; thalidomide case and chiral drugs; Geometrical isomerism: cis-trans, syn-anti and E/Z nomenclature.; Cis-trans isomerism in vision.

### **Unit III: Biologically significant chemical reactions** **(6 hours)**

Aldol condensation (Glucogenesis), Retro-alcohol (Glycolysis), Benzoin condensation (umpolung-decarboxylation of pyruvate in the presence of TPP), Claisen condensation (Synthesis of fatty acids), Michael addition (Dehydrases), Cannizzaro (Sugar metabolism), Baeyer Villiger reaction (FAD dependent ketone synthesis), Pinacole-pinacolone rearrangement (1,2-carbon carbon shift), Isomerisation(Glycolysis), Redox reaction(Lactate dehydrogenase).

### **Unit IV: Carbohydrates** **(6 hours)**

Classification of carbohydrates, reducing and non-reducing sugars, biological functions, linkage between monosaccharides, general properties and reactions of glucose and fructose, their open chain structure, epimers, mutarotation and anomers, reactions of monosaccharides, configuration, cyclic structure (exclude structure elucidation) and Haworth projection formulae of glucose and fructose: structure of disaccharides (sucrose, maltose, lactose); polysaccharides- classification, structure of important members, storage polysaccharides (Glycogen, Starch) and structural polysaccharides (Cellulose, chitin, peptidoglycans and glycosaminoglycans)

## **Unit V: Lipids**

**(8 hours)**

Introduction, classification, biological importance of triglycerides, phospholipids, glycolipids, eicosanoids and steroids (cholesterol). Oils, Fats and Waxes: Common fatty acids present in oils and fats, essential fatty acids, characteristics of fatty acids and fats (saponification, iodine, acid, acetyl and peroxide values). Rancidity and reversion of fats; waxes, trans-fats and their biological significance.

## **Practical component: (60 hours)**

1. Purification of organic compounds by recrystallization using the following solvents:
  - i. Water
  - ii. Water-Alcohol
  - iii. Alcohol
2. Criterion of purity of organic compound- melting point, mixed melting point and boiling point of organic compounds.
3. Estimation of saponification value of fat/oil.
4. Estimation of iodine value of fat/oil.
5. Qualitative tests for carbohydrates and lipids
6. Chromatography
  - a) To separate a mixture of sugars by circular paper chromatography
  - b) To separate a mixture of lipids in a sample by Thin Layer Chromatography.

## **Essential/recommended readings**

- A Guidebook to mechanism in organic chemistry (2003) 6 th ed., Sykes, P. New York: John Wiley & Sons. Inc
- Organic Chemistry (2014) 7 th ed., Morrison, R.T., Boyd, R.N., Bhattacharjee, S. K., Pearson Education
- Stereochemistry of Organic Compounds (1994), Eliel, E. L., Wilen, S. H. John Wiley & Sons.
- Stereochemistry: Conformation and Mechanism (2015) 8 th ed., Kalsi, P. S. New Age International
- Organic Chemistry (2013), Madan, R. L. Tata McGraw Hill Education Private Limited, New Delhi
- Organic Chemistry (2020) 8th Edn., Bruice, P. Y., Pearson

## **Suggestive readings: Nil**

**Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.**

## DISCIPLINE SPECIFIC CORE COURSE – 2: Photobiology

### CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (If any)
		Lecture	Tutorial	Practical/Practice		
Photobiology	DSC-102	2	0	2	10+2 from any recognized Board with Biology & Candidates must appear in CUET in the following subject combination: <b>Physics+ Chemistry+ Biotechnology</b> <b>Biology/</b>	Nil

### Learning Objectives

The Learning Objectives of this course are as follows:

- The course explores the physical properties of light and its interplay with living organisms. Light as a source of energy and information has shaped life on earth over the last 3.6 billion years. We see the world around us because the light reflected to the retina is processed to our brain (Photoreception), we breathe in oxygen because it has been evolved by the plants around us due to the light dependent Photosynthesis. Where there is no natural light, some organisms produce their own (Bioluminescence). Maintaining coordination with the changing light regime with changing seasons is fundamentally important to various aspects of living organisms across latitudes (Photoperiodism). Every part of the spectrum is used in one way or the other by different life forms. In this paper students will be able to appreciate the delicate processes of life that are dependent on light.

### Learning outcomes

A student studying this course can:

- Understand and appreciate the dual nature of light.
- Comprehend the impact of light on biodiversity from pole to pole.
- Gain knowledge about the various photoreceptors in plants and animals and will appreciate and understand the mechanism of photosynthesis.
- Understand bioluminescence, photoperiodism and biological rhythms.
- Gain knowledge about the ecological and physiological responses to light.

## **SYLLABUS OF DSC-2**

### **Unit 1: Introduction to Light and Life ( 6 hours)**

Latitudinal Diversity gradient. Altitudinal and latitudinal variations in light intensity and photoperiod. Light as an ecological factor affecting distribution, physiological processes of plants and animals (Phyto and Zoo geography), in terrestrial and aquatic ecosystems.

### **Unit 2: Bioluminescence and Photoreception (6 hours)**

Discovery, diversity and functions of Bioluminescence. Comparative account of chemistry and functional roles of photoreceptors in plants: chlorophylls, carotenoids, phycobiliproteins, bacteriochlorophylls, etc. Photoreception in animals, evolution of eyes, color vision and visual processing in the human eye.

### **Unit 3: Photosynthesis (6 hours)**

History, Spectrum of autotrophs, Photosynthetic equation, Photosynthetic electron transport (cyclic and non-cyclic), photolysis of water, oxygen-evolving complex (OEC), concept of Reaction centers, Q-cycle, Dark Reactions in Photosynthesis, C3, C4, CAM cycle, photorespiration (C2 cycle).

### **Unit 4: Photoperiodism (6 hours)**

Phytochrome mediated responses in Plants, Animal responses to changing photoperiodism. Morphological, Anatomical, Physiological and behavioral adaptations to extreme light conditions in plants and animals.

### **Unit 5: Ecological and physiological responses to Light (6 hours)**

Morphological and physiological color change in animals. Light as an inducer for biosynthesis/activation of biomolecules (Vitamin D, Melatonin, Thymine dimer formation, RuBisCo. Three rythmn domains, Biological clocks and circadian rythmn, night shift disorders and jet lag.

### **Practical component: (60 hours)**

1. To study light penetration in water using Secchi disc.
2. To demonstrate the effect of light on soil fauna using Berlese funnel setup.
3. To study the effect of light and darkness on the chromatophores of fish.
4. To test / survey for color blindness using Ishihara charts.
5. To study various Bioluminescent organisms using photographs- *Photinus pyralis*, *Aequorea victoria*, Vampire squid, Anglerfish, Lanternfish, Viperfish, Black dragonfish, *Omphalotus nidiformes*
6. Diel vertical migration using photographs
7. Measurement of light using Luxmeter under various conditions
8. To study structure of chloroplast- through photographs
9. Separation of Chloroplast pigments by Paper Chromatography/ Chemical Separation of

Chloroplast pigments

10. To study the effect of Light intensity and CO<sub>2</sub> concentration on the rate of Photosynthesis
11. Demonstration of Hill's Reaction and study the effect of Light intensity (any 2 light conditions).
12. Demonstration of Etiolation and de-etiolation.

### Essential/ recommended Readings:

- Björn, L. O. (2015) 3rd Ed. *Photobiology: Science of Light and Life*, L.O. Bjorn., Springer
- Buchanan, B. B., Gruisse, W., and Jones, R. L. (2000). *Biochemistry and molecular biology of plants*. Rockville, Md.: American Society of Plant Physiologists.
- Huner, N. and Hopkins, W. (2013). *Introduction to Plant Physiology*. In: 4th ed. John Wiley & Sons, Inc.
- Kohen E., Santus R., Hirschberg J.G. (1995) 1st Ed., *Photobiology* Academic Press
- Randall D., Burggren W., & French k. (2001) 5th Ed. *Eckert, Animal Physiology Mechanisms and Adaptations*. W.H. Freeman and Co.

### Suggested Readings:

- Gross M. (2003). Light and Life. Oxford University Press
- Shimomura O., (2012) Bioluminescence: Chemical Principles and Methods, World Scientific,
- Taiz, L., & Zeiger, E. (1991). *Plant physiology*. Redwood City, Calif: Benjamin/Cummings Pub. Co.

**Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.**

### DISCIPLINE SPECIFIC CORE COURSE – 3: Diversity in lifeforms I

#### CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Diversity in Life forms I	DSC-103	2	0	2	10+2 from any recognized Board with Biology & Candidates must appear in CUET in the following subject combination: <b>Physics+ Chemistry+ Biotechnology Biology/</b>	Nil

## **Learning Objectives**

The Learning Objectives of this course are as follows:

- The course will acquaint students with variations and variability in the living world and the objectives of biological classification. The course covers important aspects of biodiversity and its components with emphasis on understanding the features of Kingdom Animalia and Plantae and systematic organization of the same based on their evolutionary relationships. Students will also understand the importance of taxonomy and structural organization of animals from Protista to Echinodermata to appreciate the diversity of non-chordates living in varied habitats. They will study about the general characteristics and significance of Algae, Fungi, Bryophytes and Pteridophytes

## **Learning outcomes**

After studying this course the student will be able to:

- Understand characteristic features of different plant and animal life forms.
- Identify, classify and differentiate diverse non-chordates based on their morphological, anatomical and systemic organization.
- Understand similarities and differences in life functions among various non-chordates.
- Appreciate and understand the relevance of wild relatives of cultivated plants, their domestication and green revolution.
- Understand the general characteristics, classification, economic importance, morphology, asexual and sexual reproduction of Algae, Fungi, Bryophytes and Pteridophytes

## **SYLLABUS OF DSC-3**

Please provide weekly distribution

### **Unit I: Algae and Fungi**

**(6 hours)**

Importance of biodiversity in daily life. Biodiversity crisis and biodiversity loss,

Five kingdom classification and the position of Algae, Fungi, Bryophytes and Pteridophytes.

**Algae:** Study of general characteristics, Outline Classification, Economic Importance, Thallus Organization and Reproduction in Nostoc, Polysiphonia, Ectocarpus.

**Fungi** – General Characteristics, Outline Classification, Economic Importance, Thallus Organization and Reproduction in Rhizopus and Puccinia, Lichens (crustose, foliose and fruticose), Mycorrhiza (ectomycorrhiza and endomycorrhiza, VAM)

### **Unit II: Bryophytes and Pteridophytes**

**8 hours**

**Bryophytes:** General Characteristics; Outline Classification; Ecological and Economic Importance; Morphology, Structure and Reproduction (comparative) in *Marchantia* and *Anthoceros*

**Pteridophytes:** General Characteristics; Outline Classification; Economic Importance; Morphology, Structure and Reproduction in *Selaginella*

### **Unit III Introduction to Animal Life Forms**

**(6 hours)**

Introduction to animal diversity, Basic Taxonomy (Linnaean system of classification, Whittaker's five kingdom classification, ICZN Rules), General Characteristics of Non-Chordata and Chordata.

### **Unit IV: Non-Chordata Taxonomy and Diversity**

**(10 hours)**

Study of General Characteristics and Classification up to classes (Protista, Porifera, Cnidaria, Platyhelminthes, Aschelminthes, Annelida, Arthropoda, Mollusca, Echinodermata)

### **Practical component: (60 hours)**

#### **FLORA**

1. Study of Vegetative and Reproductive Structures through Temporary Preparations and Permanent Slides- *Nostoc*, *Oedogonium*, *Polysiphonia*; *Chlamydomonas* (Through Photograph/Electron photomicrograph)
2. Study of Asexual Stage from Temporary/ Tease Mounts- *Rhizopus Albugo*; *Puccinia* - WM uredospores, teleutospores, Section of Leaf through pustules to show conidia
3. *Marchantia*-Morphology of Thallus, W.M. Rhizoids, V.S. Thallus through Gemma Cup, Antheridiophore (Permanent slide), Archegoniophore (Permanent Slide)), *Funaria*-Morphology of Gametophyte bearing Sporophyte, W.M. Rhizoids, W.M. Leaf, W.M. Operculum, W.M. Peristome, W.M. Spores (all Temporary Slides), L.S. Capsule (Permanent Slide).
4. *Selaginella*- Morphology, T.S. Stem, W.M. Strobilus, W.M. Microsporophyll and Megasporophyll (all Temporary Slides), L.S. Strobilus (Permanent Slide), *Pteris*-Morphology, V.S. Sporophyll, W.M. Sporangium, W.M. Spores (all Temporary Slides), W.M. Prothallus with Sex Organs (Permanent Slide).

#### **FAUNA**

5. **Study of following specimens:** *Euglena*, *Paramecium*, *Sycon*, *Tubipora*, *Taenia solium*, *Ascaris Phertima*, *Hirudanaria*, *Peripatus*, *Scolopendra*, *Julus*, *Cancer*, *Daphnia*, *Apis*, *Pila*, *Dentalium*, *Octopus*, *Asterias*
6. **Dissections / Virtual demonstration:** Nervous system of Cockroach, Salivary apparatus and Ovary of Cockroach.
7. Study of adult *Fasciola hepatica*, *Taenia solium* and their life stages (Slides/micro-photographs).
8. Study of following permanent Slides.
  - a. T.S. and L.S. of *Sycon*.
  - b. Crustacean larvae (W.M. Mysis, W.M. Megalopa, W.M. Zoaea).
9. To study faunal composition of water samples (Lucky drop method).
10. Field trip on: Biodiversity park/reserve/ NBPGR. (Botany + Zoology)

**Essential/ recommended readings:**

- Barnes, R.D. (1982). *Invertebrate Zoology*, 5th. Edition
- Campbell N. A., (2008). *Biology* 8th Edition, Pearson
- Barrington, E.J.W. (2012). Invertebrate Structure and Functions. II Edition, EWP Publishers
- Singh, V. (2010). *A text book of botany*. Rastogi Publications.
- Ennos, R., & Sheffield, E., (2000). *Plant Life*. UK: University Press, Cambridge.

**Suggested readings:**

- Ingrowille, M., (1992). *Diversity and Evolution of land plants*. Chapman and Hall
- Wilson, E. O., (1998). *Biodiversity*. National Academic Press.
- Barnes, R.D. (2006). Invertebrate Zoology, VII Edition, Cengage Learning, India.

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